

WATER POLICY INTERIM  
COMMITTEE 2021-22

July 15, 2021

Exhibit 9

**Water research (85-2-105, MCA)**

Water Policy Interim Committee  
July 15, 2021

John Metesh  
Director and State Geologist  
Montana Bureau of Mines and Geology

# GROUNDWATER



## Assessment Program

Established by the **Montana Legislature (85-2-901)** in **1991** to improve the understanding of groundwater resources by systematically collecting, interpreting, and disseminating groundwater information.

### **Groundwater Monitoring Program –**

Statewide network of over 800 wells that tracks how Montana's aquifers respond to seasonal, climatic, land-use.

### **Groundwater Characterization Program –**

Systematically assess and document the hydrogeology and quality of the State's major aquifers

### **Groundwater Information Center (GWIC) –**

Repository for the State's groundwater information

## Investigation Program

Established by the **Montana Legislature (85-2-525)** in **2009** to gather data, compile existing information, conduct field studies and prepare a detailed hydrogeologic assessment for each subbasin.

### **Site Specific Studies –**

Addressing **groundwater** resource concerns in support of statewide and local decisions regarding groundwater.

### **Water Resource Questions –**

Effects of existing and proposed groundwater development on streamflow, changes in land use, and drought on groundwater and surface-water supplies.

### **Project Nominations –**

Allows local communities and other stakeholders to nominate projects

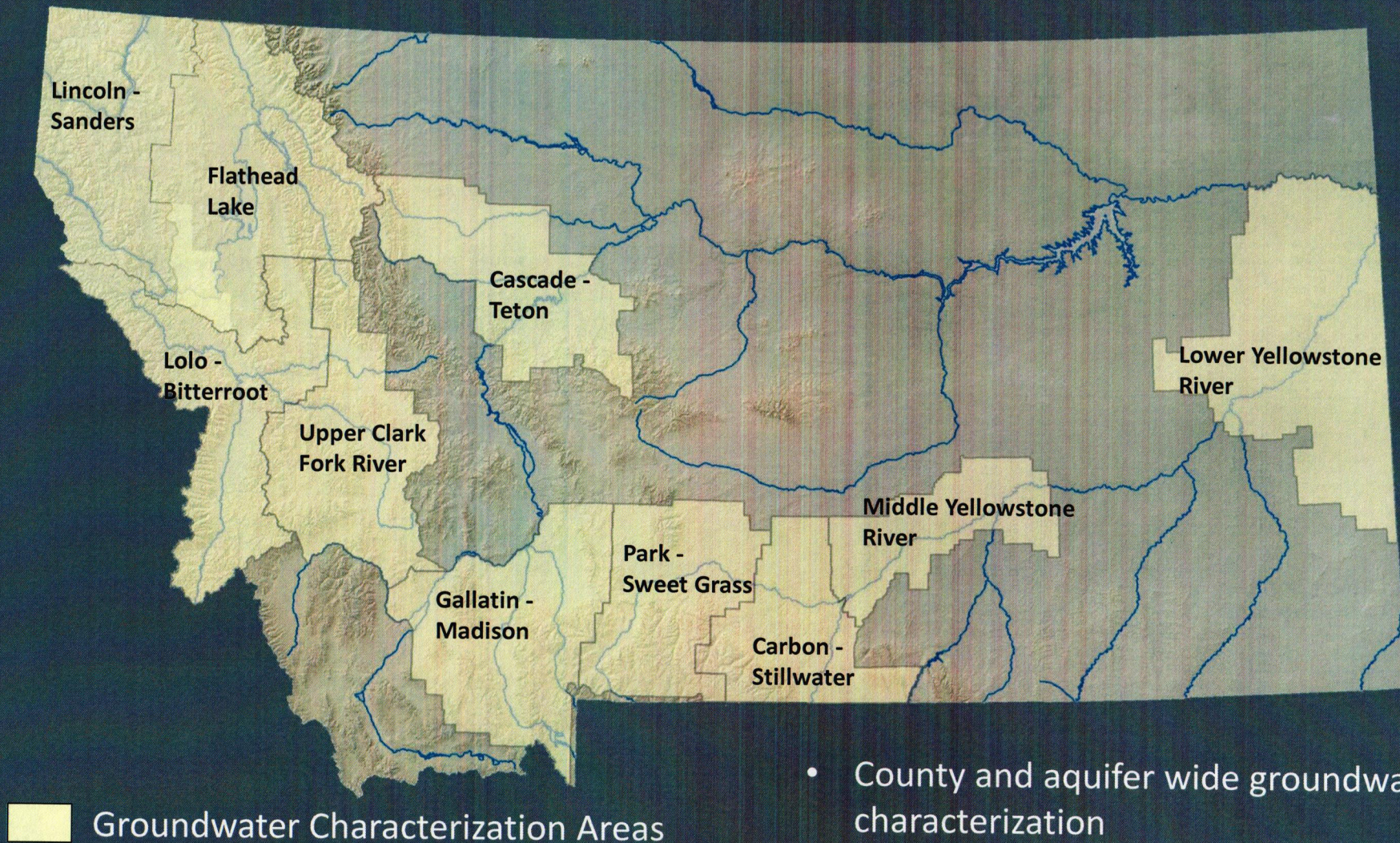
## GROUNDWATER STEERING COMMITTEE

Montana Legislature 2-15-1523

Prioritizes groundwater characterization areas, oversees expenditures and approves of workplans.

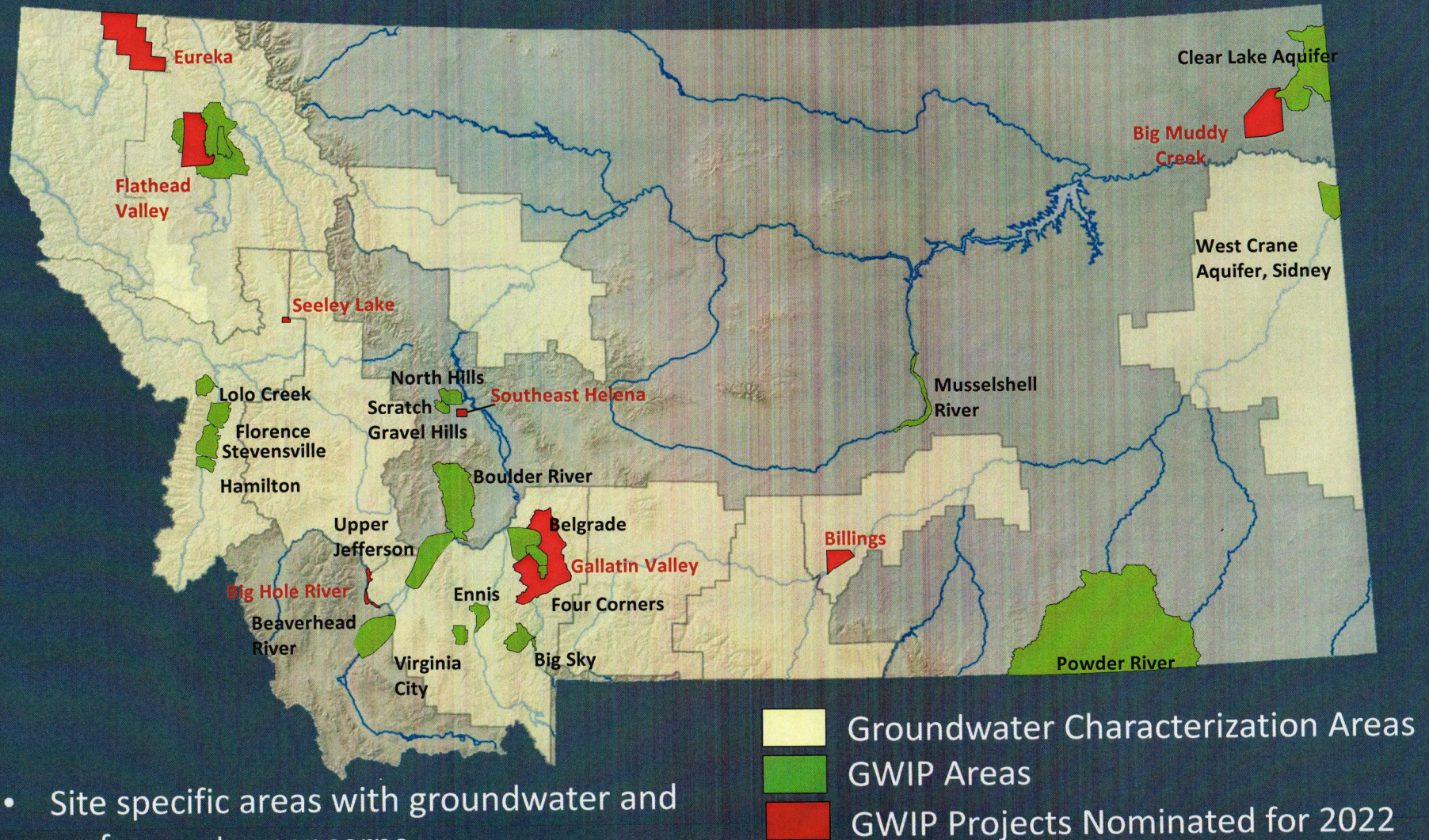
Prioritizes projects based on based upon current and anticipated growth of agriculture, industry, housing, and commercial activity.

# Ground Water Assessment Program



- County and aquifer wide groundwater characterization
- Ground Water Information Center
- State-wide groundwater monitoring network

# Ground Water Investigation Program (GWIP)



## Emerging (?) Issues (general)

- Climate change and drought
- Influence of irrigation on groundwater and surface water
  - Irrigation method efficiency and the effects on irrigation return flows
  - Canal conveyance efficiency and groundwater recharge
- Water availability and is it sufficient to meet Montana's needs with changing land use
- Water quality and the effects of increased residential, commercial and industrial development on water resources
  - Nitrates from wastewater treatment and agriculture
  - Salinity from natural sources and from changes in land use
- Natural and artificial water storage projects

# Emerging (?) Issues (GWAP+)

## 2021 Characterization and Cooperative Monitoring

Eureka	sampling, characterization
West Yellowstone	Monitoring wells (NWQMP and NPS)
Eastern MT	Flowing wells, shut in, monitoring (DNRC)
Stillwater River	Irrigation return, canal lining (DNRC, NRCS)
East – Central MT	Water supply, new wells (NRCS)

# State-Wide Groundwater Monitoring Network

## 2017 Flash Drought Impacts

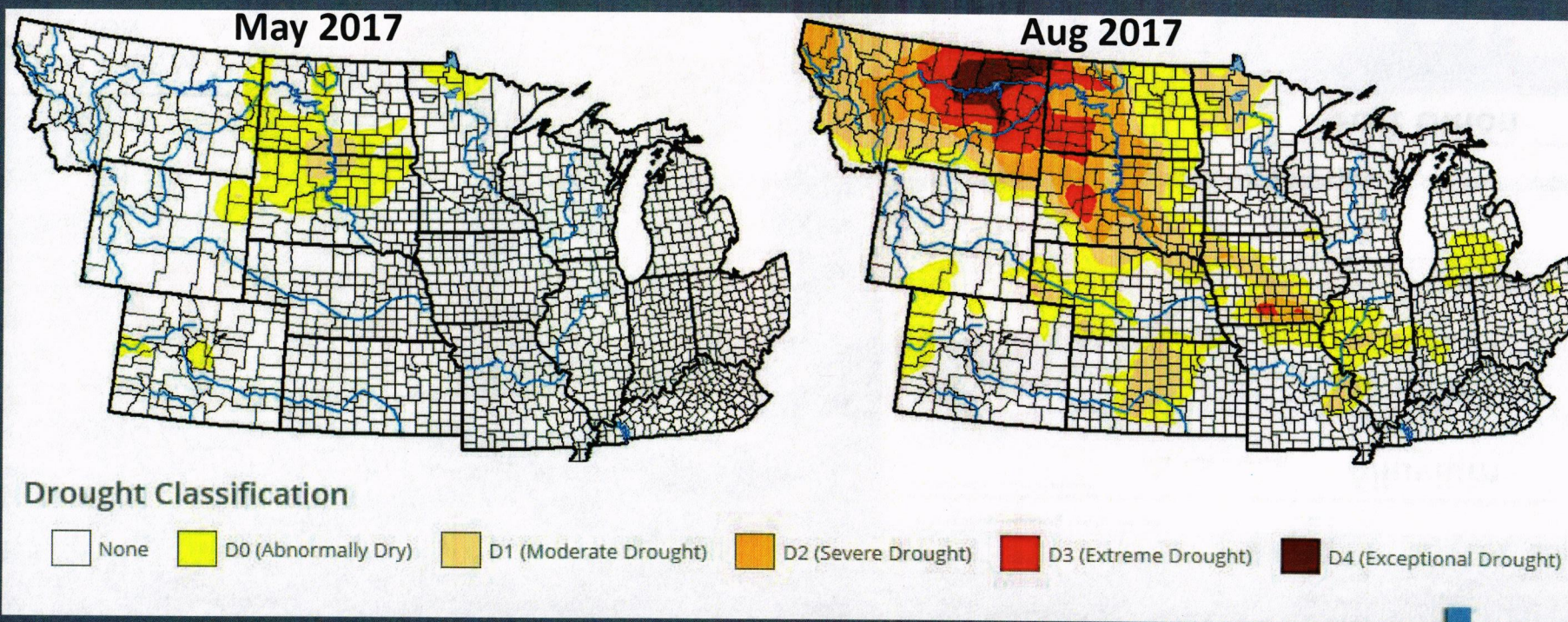
### News & Features

### 'Flash Drought' Spreads Across Montana in Less Than 3 Months

More than a third of the entire state is now in severe, extreme or exceptional drought

BY ASSOCIATED PRESS // AUG 3, 2017

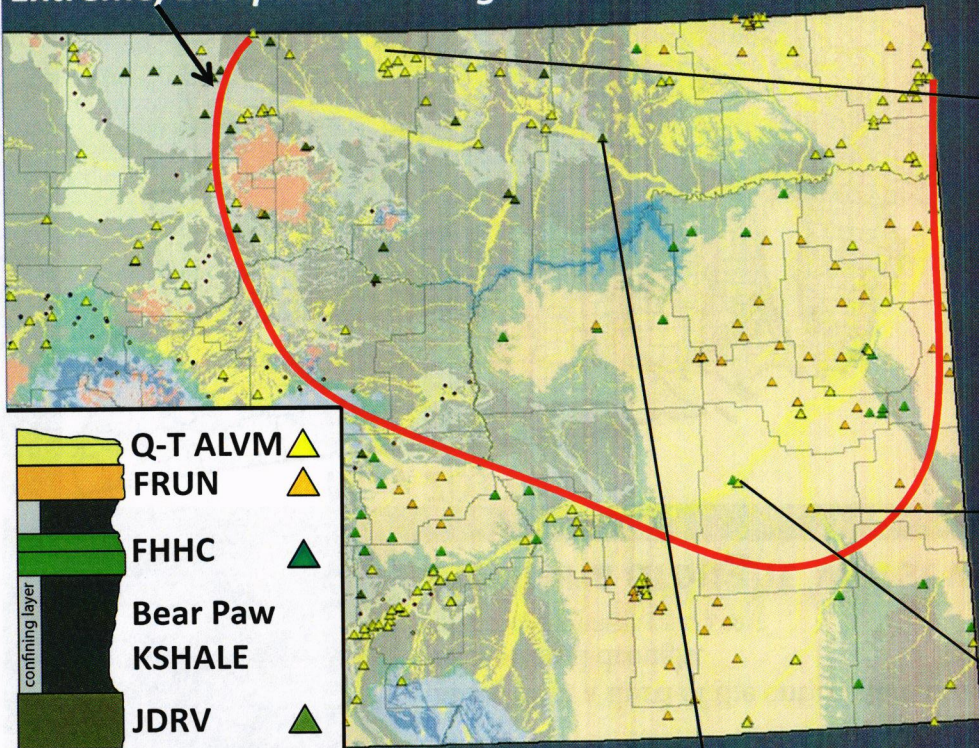
**Montana drought 'worst we've seen in 100 years'**



# State-Wide Groundwater Monitoring Network

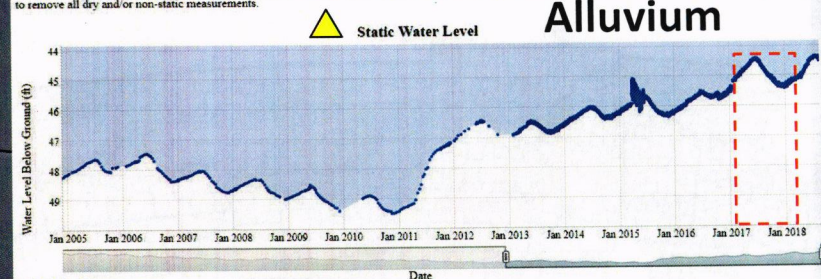
## 2017 Groundwater Levels not affected

**Extreme/Exceptional Drought**



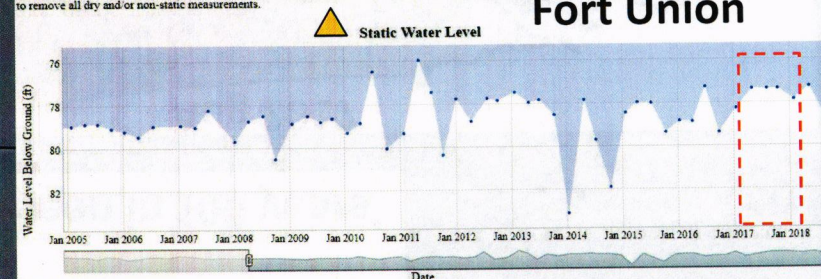
### Groundwater Information Center Well Hydrograph

The following chart represents the current hydrograph for this well. Data reported are static water levels in feet below ground surface. A filter has been applied to the data to remove all dry and/or non-static measurements.



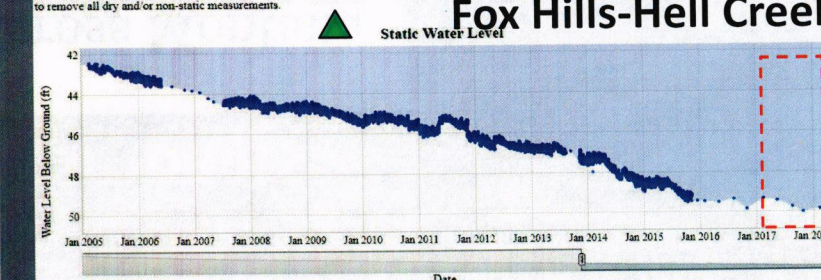
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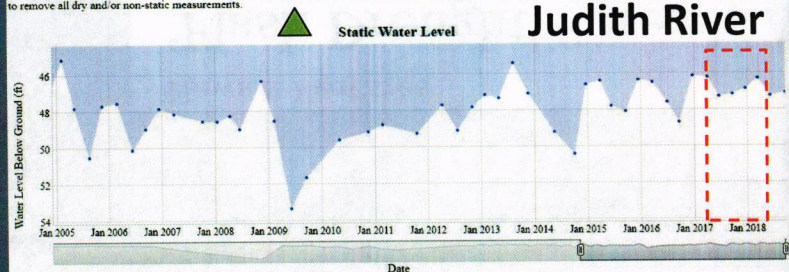
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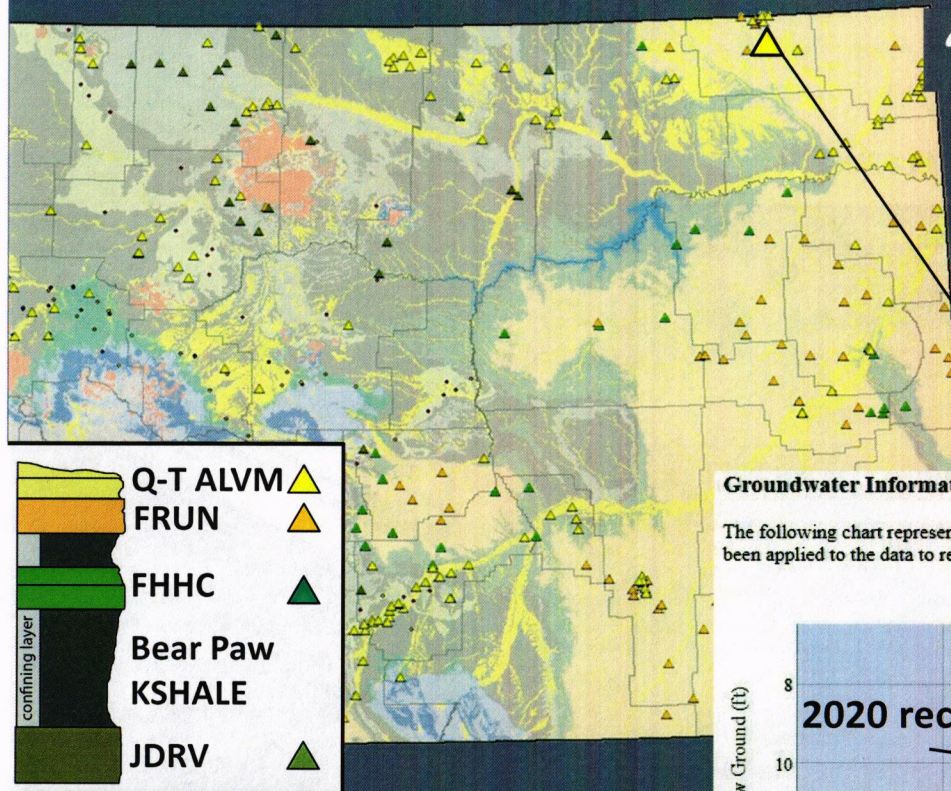
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# State-Wide Groundwater Monitoring Network

Partnership with MT Dept of Ag and MCO



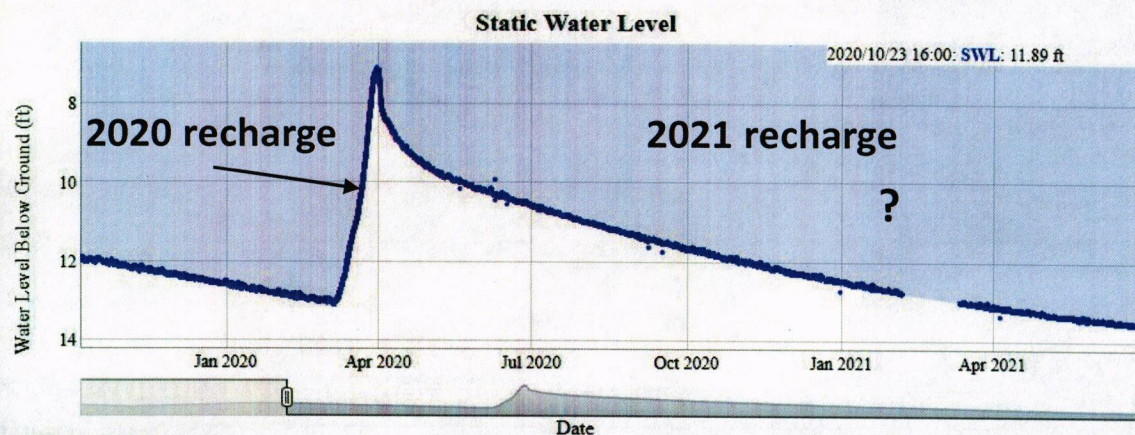
'Real-time' GW monitoring at Mesonet Sites

Site near Scobey 2020 – 2021 GW levels

- 2021 lack of E MT snow cover
- Diminished GW recharge

Groundwater Information Center Well Hydrograph

The following chart represents the current hydrograph for this well. Data reported are static water levels in feet below ground surface. A filter has been applied to the data to remove all dry and/or non-static measurements.

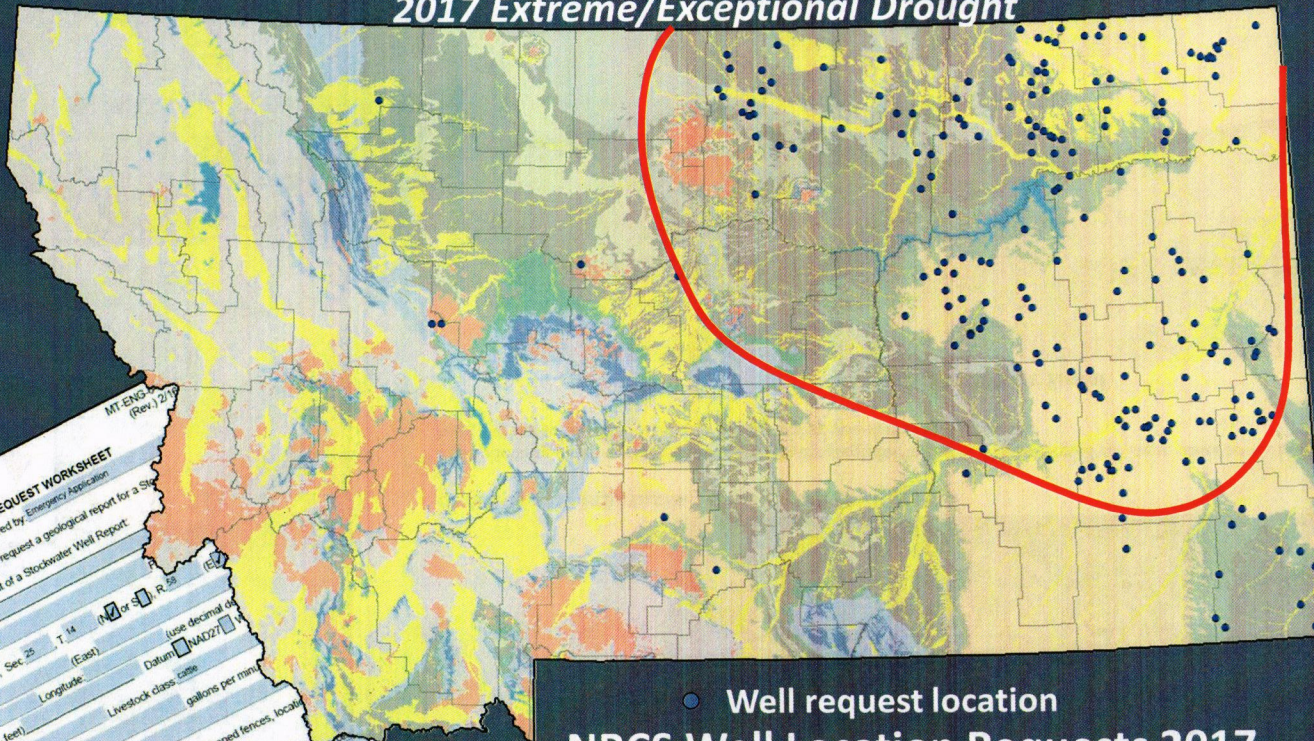


GWIC Id: 214376  
Site Name: MDA WELL DAN-01  
Location: 36N48E16ABAA  
Total Depth: 30.1 feet

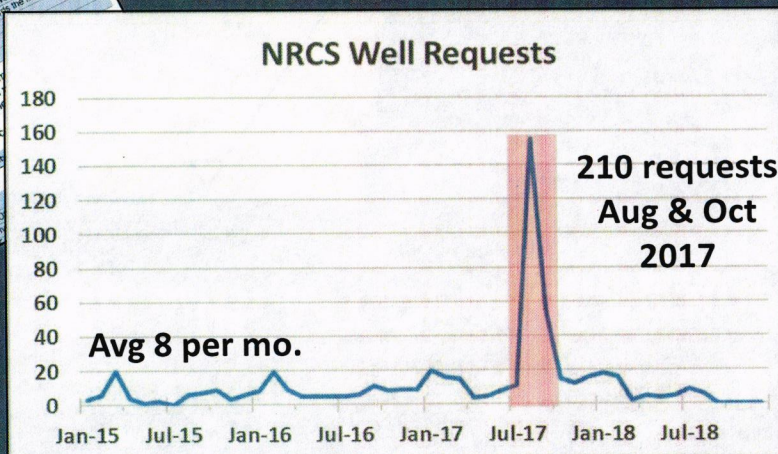
# State-Wide Groundwater Monitoring Network

Drought Increases Groundwater Demand

2017 Extreme/Exceptional Drought



Well request location  
NRCS Well Location Requests 2017



U.S. Department of Agriculture  
Natural Resources Conservation Service

**STOCKWATER WELL REPORT REQUEST WORKSHEET**  
Date Submitted: 8/10/17 MT ENG-14 (Rev. 2/10)

This form has been developed to help field personnel request a geological report for a Stockwater Well Report. Date Required by: Emergency Application

The following data are required for the development of a Stockwater Well Report:

Cooperator: Jay Creek Ranch Inc. (Van Stokoy)  
Address: 203 Georgetown Drive, Genesee, MT 59230  
Well location: 1/4, 1/4, Sec. 25, T. 14, R. 55 (East)  
Longitude: (use decimal of)  
Latitude: (use decimal of)  
Livestock class: cattle  
Gallons per minute: 100  
Power supply: solar  
Required production volume: 5  
Seasons of use: summer & fall

Enclose a topographic map showing ALL of the planning unit, actual and planned fences, local well and pipelines (if any), power lines (if any), and access for drilling equipment.

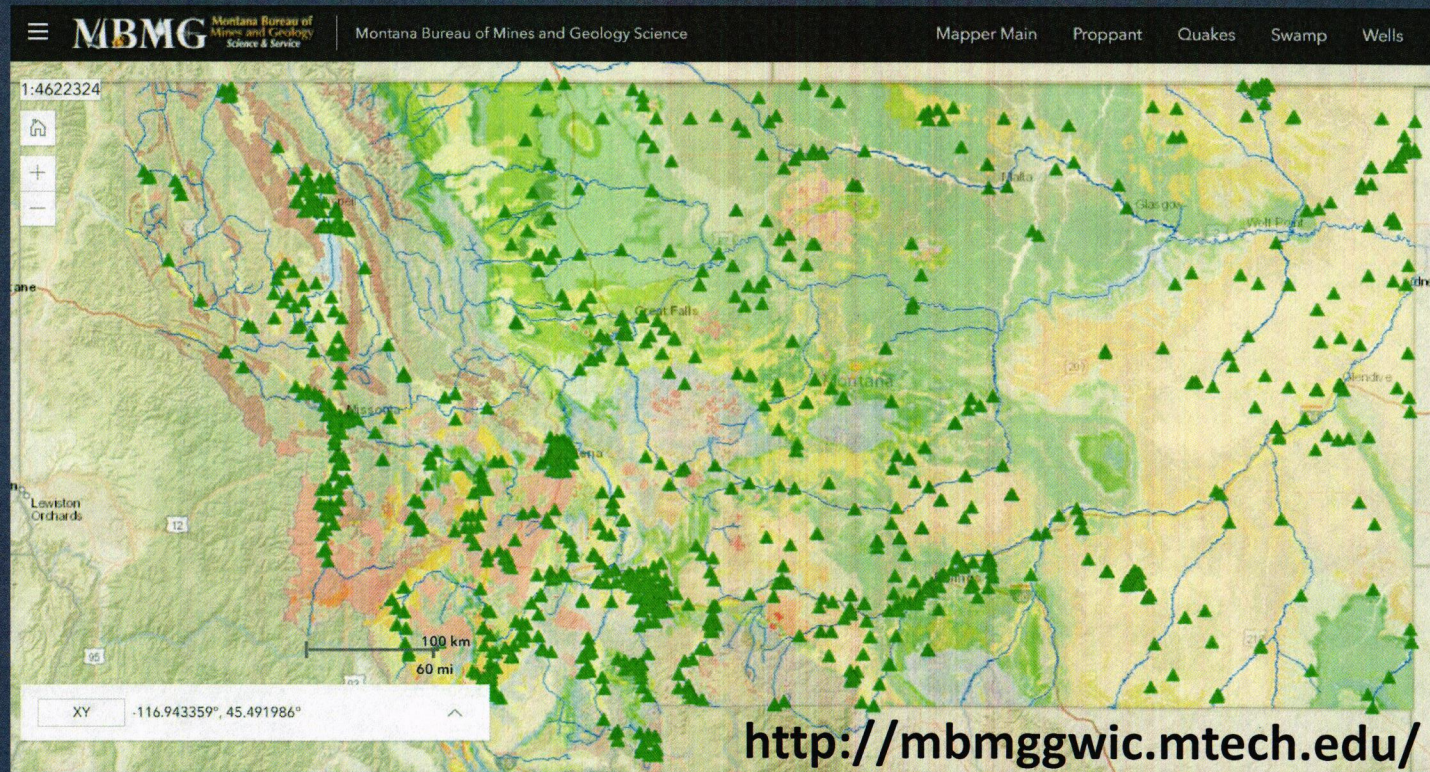
Special considerations include land use restrictions due to ownership, data from the National Wetlands Inventory, and other information. Other information includes location of springs, seeps, and other features that can be used to locate planned well location locations. Data from the Montana Wetlands Inventory can be used to locate planned well location locations. Data from the Montana Wetlands Inventory can be used to locate planned well location locations.

Requesting Field Office: Area Office: Miles City  
Assisted by: Katrina Johnson, DC  
Email Address: katrina.johnson@aphis.usda.gov  
Area Address: USDA - NRCS, Miles City Area Office, 3100 Valley Drive, Miles City, MT 59701

Send to: Dan Elythe, Senior Research Hydrogeologist, Montana Bureau of Mines and Geology 1300

# State-Wide Groundwater Monitoring Network

## Collaborative Effort



## Monitoring Network Cooperators

### Federal and Tribes

- US Geological Survey
- National Park Service
- CSKT

### State Agencies

- MT Dept. of Agriculture
- MT Climate Office

### Local Agencies and Counties

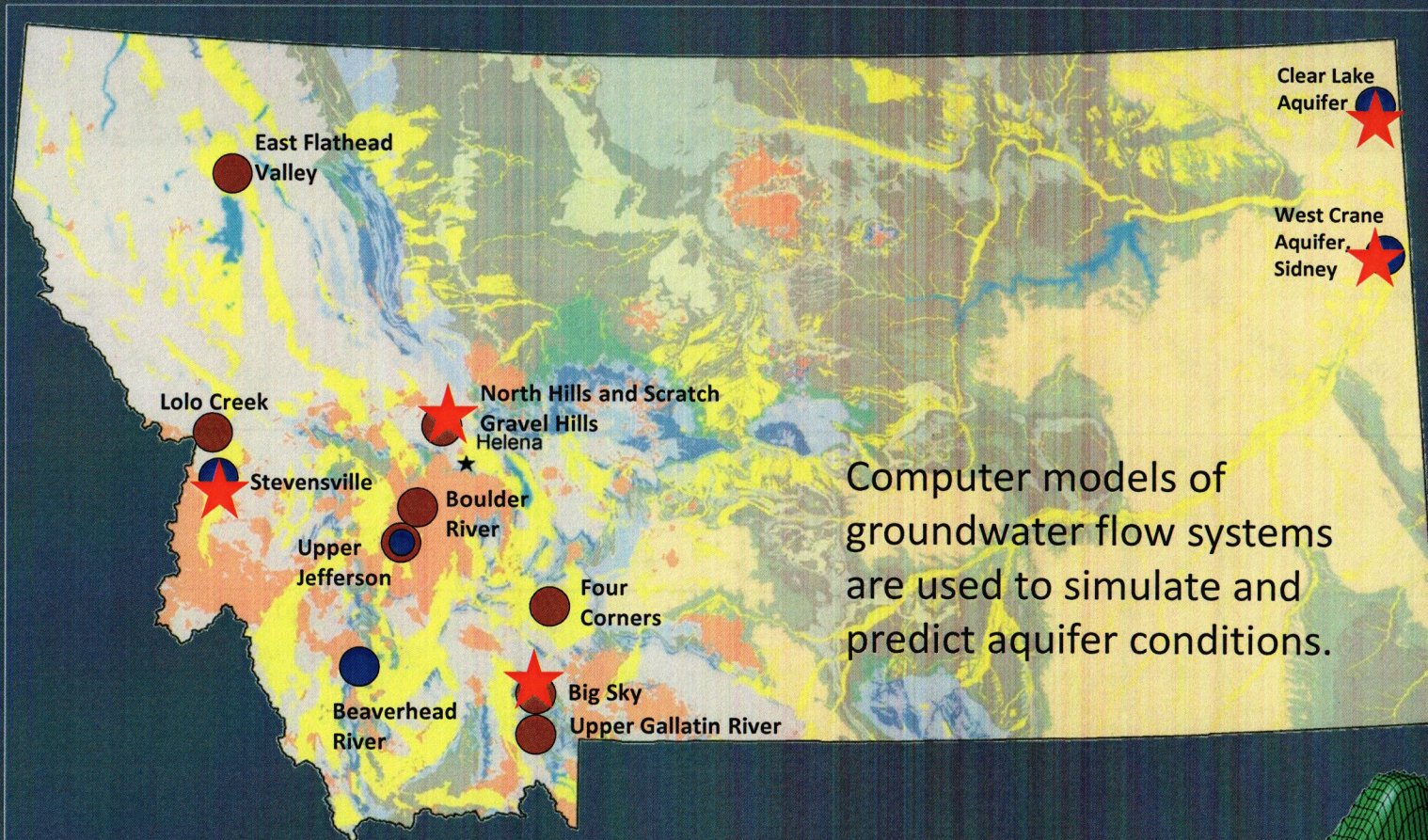
- Gallatin LWQD
- Lewis & Clark WQPD
- Missoula Valley WQD
- Sheridan Co.

# Emerging (?) Issues (GWIP)

## 2021 Project Nominations

Lower Big Hole River	Irrigation return quantity, temperature
Big Muddy Creek	Irrigation supply, stream depletion
Eureka	Water supply, stream depletion
Gallatin Valley	Gravel pits, stream depletion
Edgar	Irrigation return quantity, temperature
Seeley Lake	Ground water quality
Helena Valley (SE)	Water supply, recharge
Flathead (West)	Water supply, recharge

# Groundwater Modeling Changing Conditions



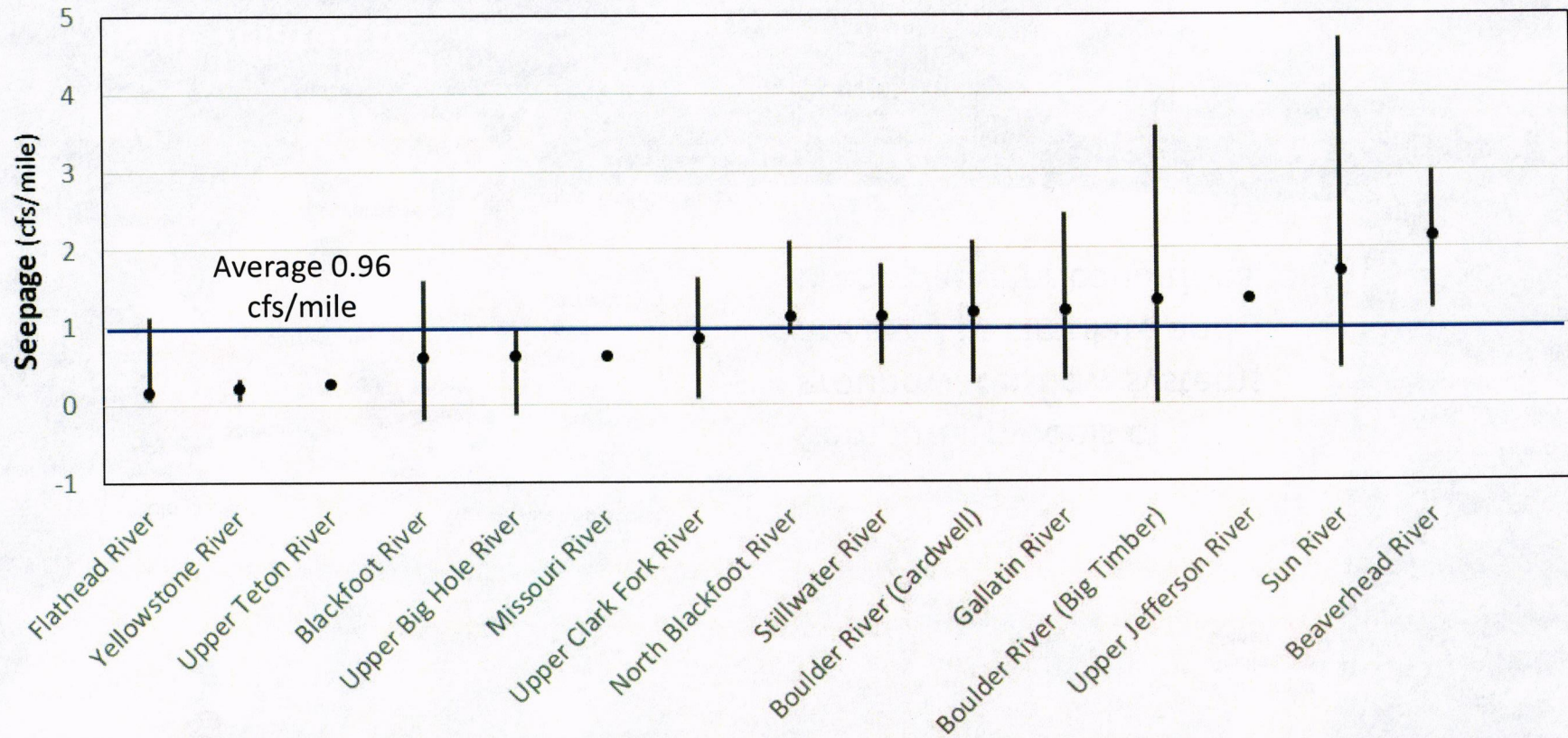
## Issue related to:

- Red Circle: Residential/commercial development
- Blue Circle: Irrigation

Red Star: Model revisited (water level response, ASR etc.)



# Canal Seepage

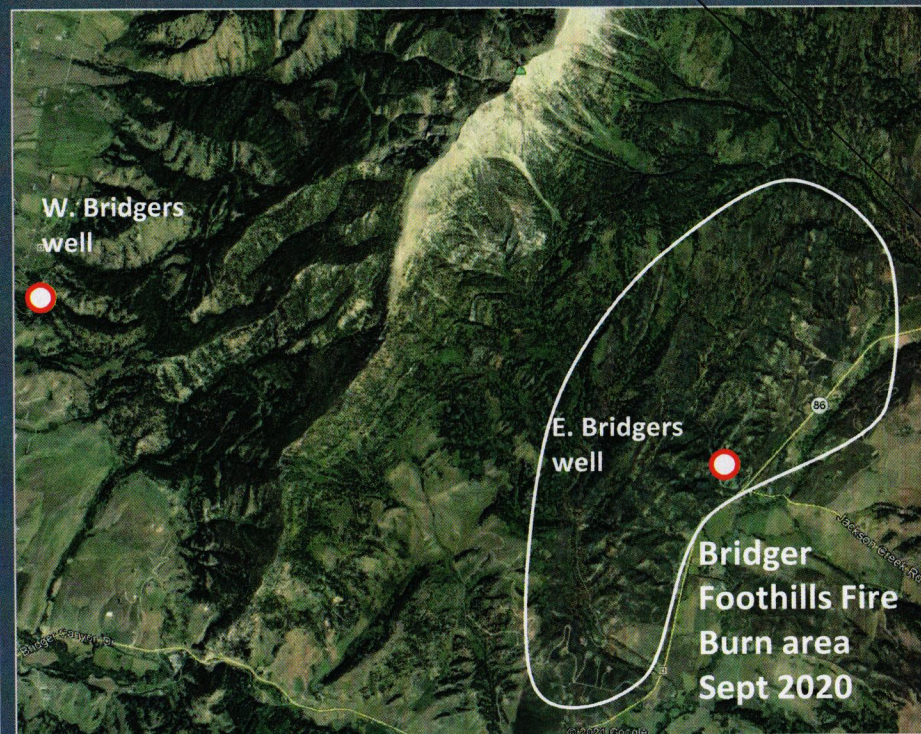
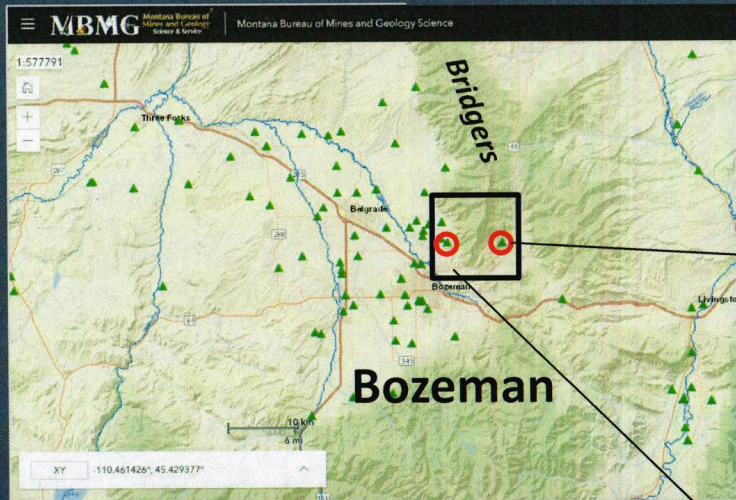


Data compiled from studies by the MBMG, DNRC and USGS



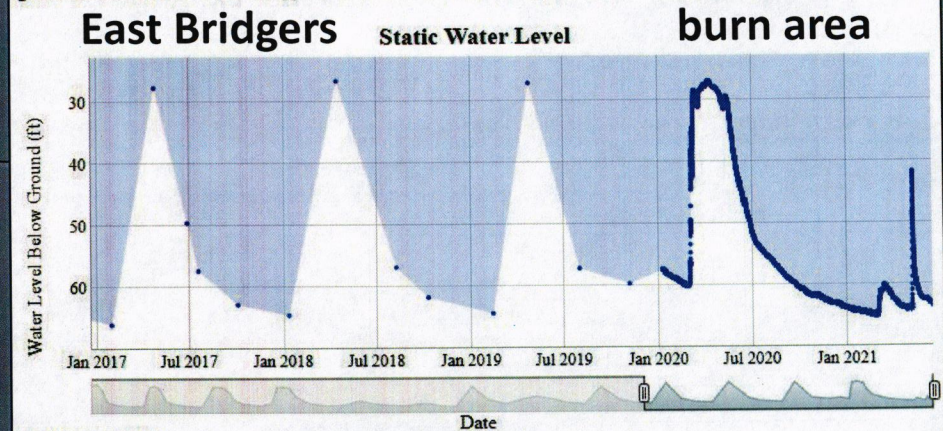
# State-Wide Groundwater Monitoring Network

## 2021 -- Drought or Wildfire impacts ?



## Groundwater Information Center Well Hydrograph

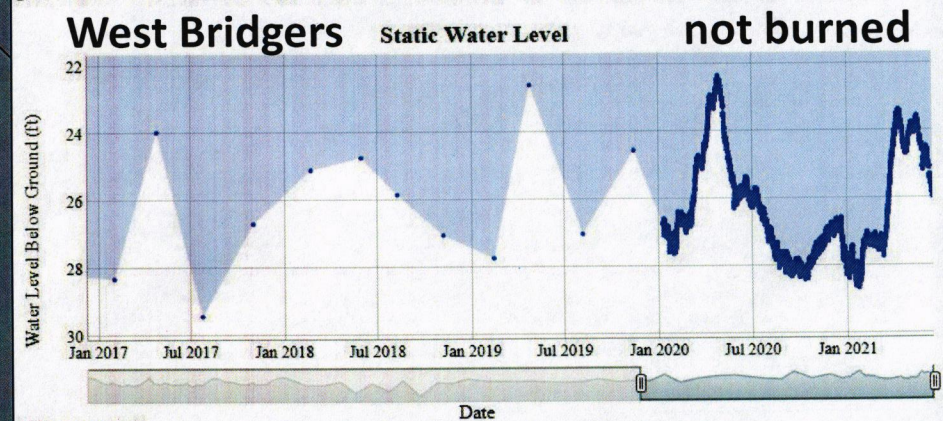
The following chart represents the current hydrograph for this well. Data reported are static water levels in feet below ground surface. A filter has been applied to the data to remove all dry and/or non-static measurements.



GWIC Id: 213610  
Site Name: BRIDGER SHADOWS TRUST - MIKE CHRISTIANSON  
Location: 01S07E19ACBA  
Total Depth: 304 feet

## Groundwater Information Center Well Hydrograph

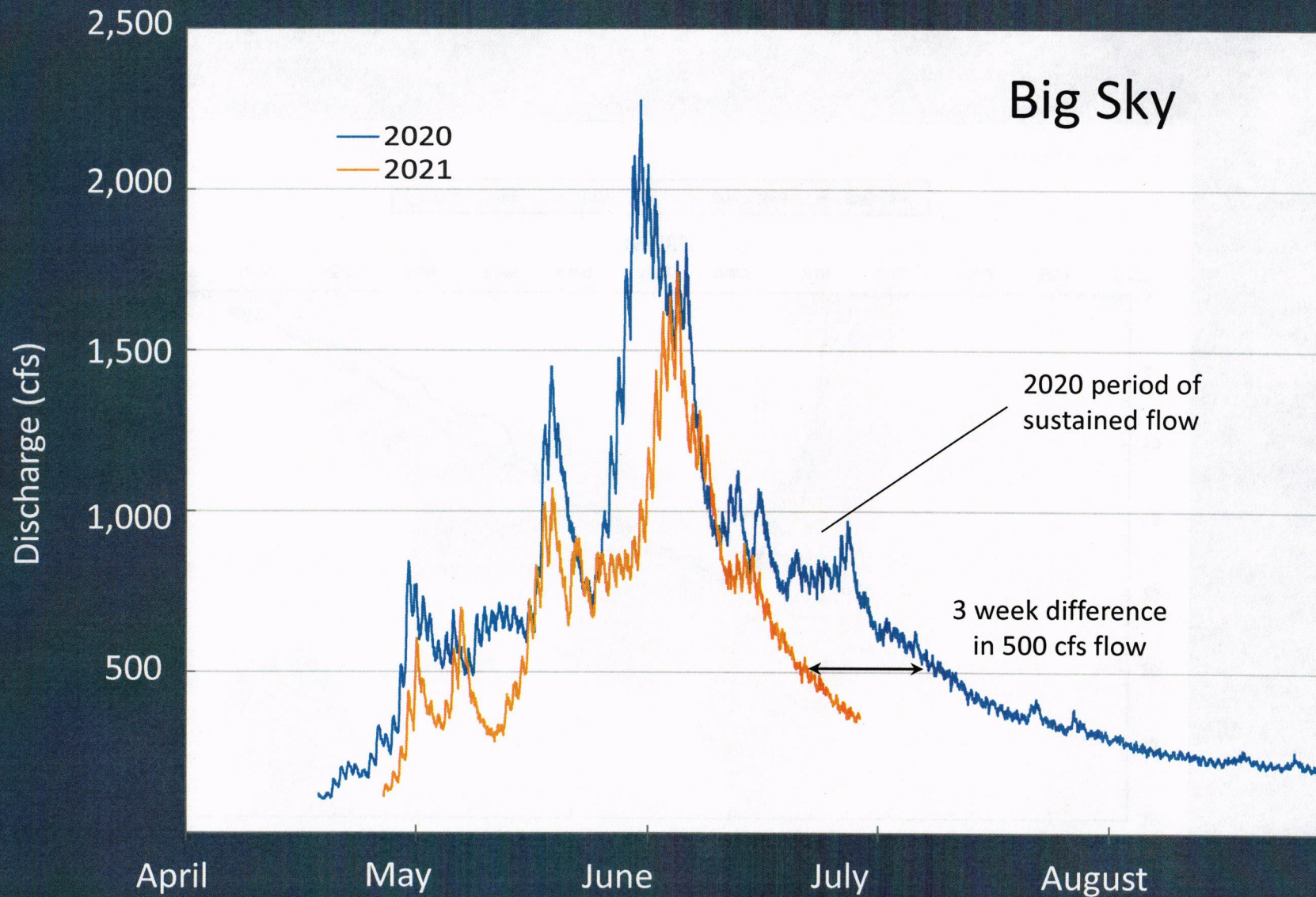
The following chart represents the current hydrograph for this well. Data reported are static water levels in feet below ground surface. A filter has been applied to the data to remove all dry and/or non-static measurements.

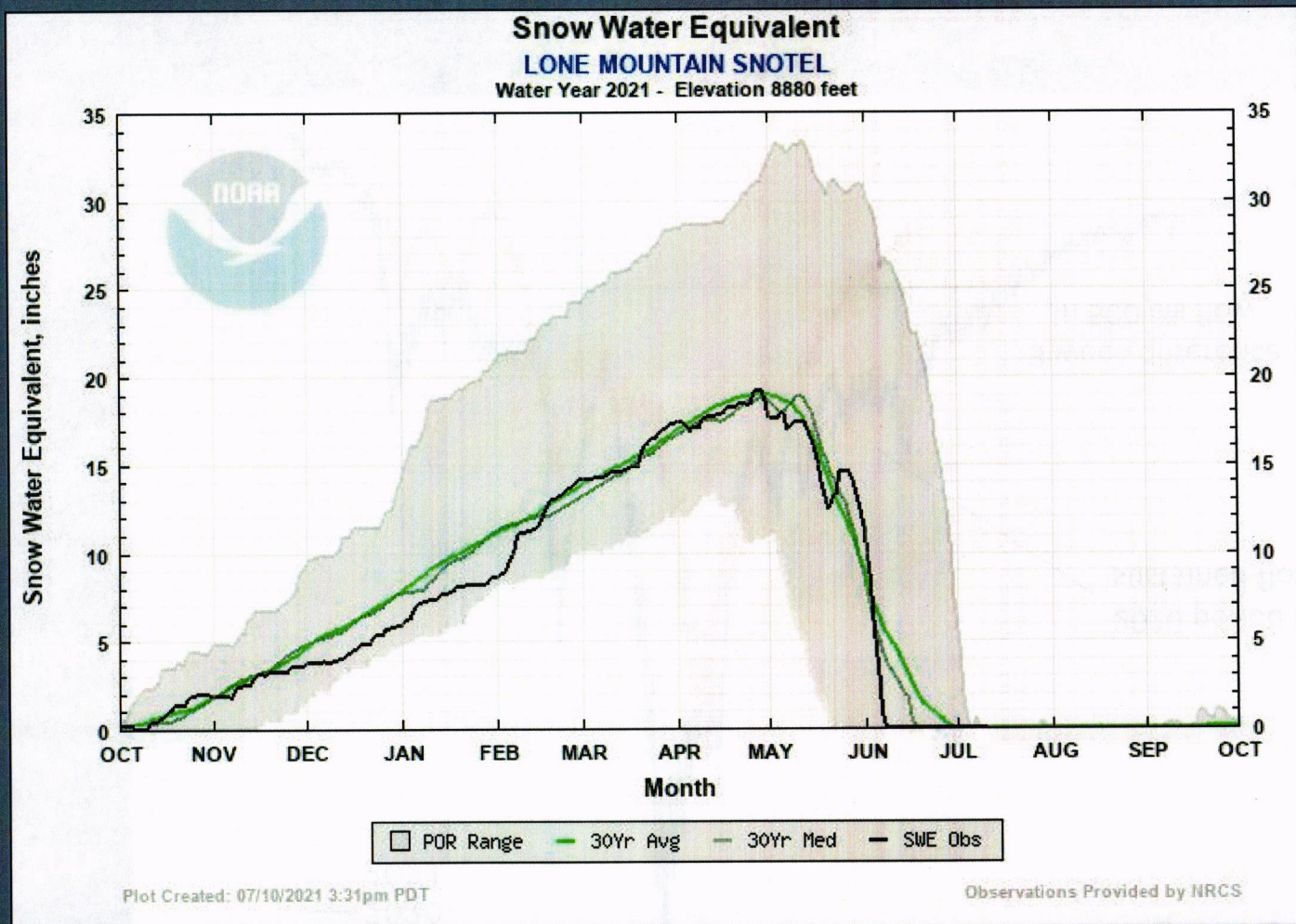


GWIC Id: 91960  
Site Name: SPERRY RAY  
Location: 01S06E20ACAA  
Total Depth: 51 feet

# Gallatin River below Twin Cabin Creek

Big Sky



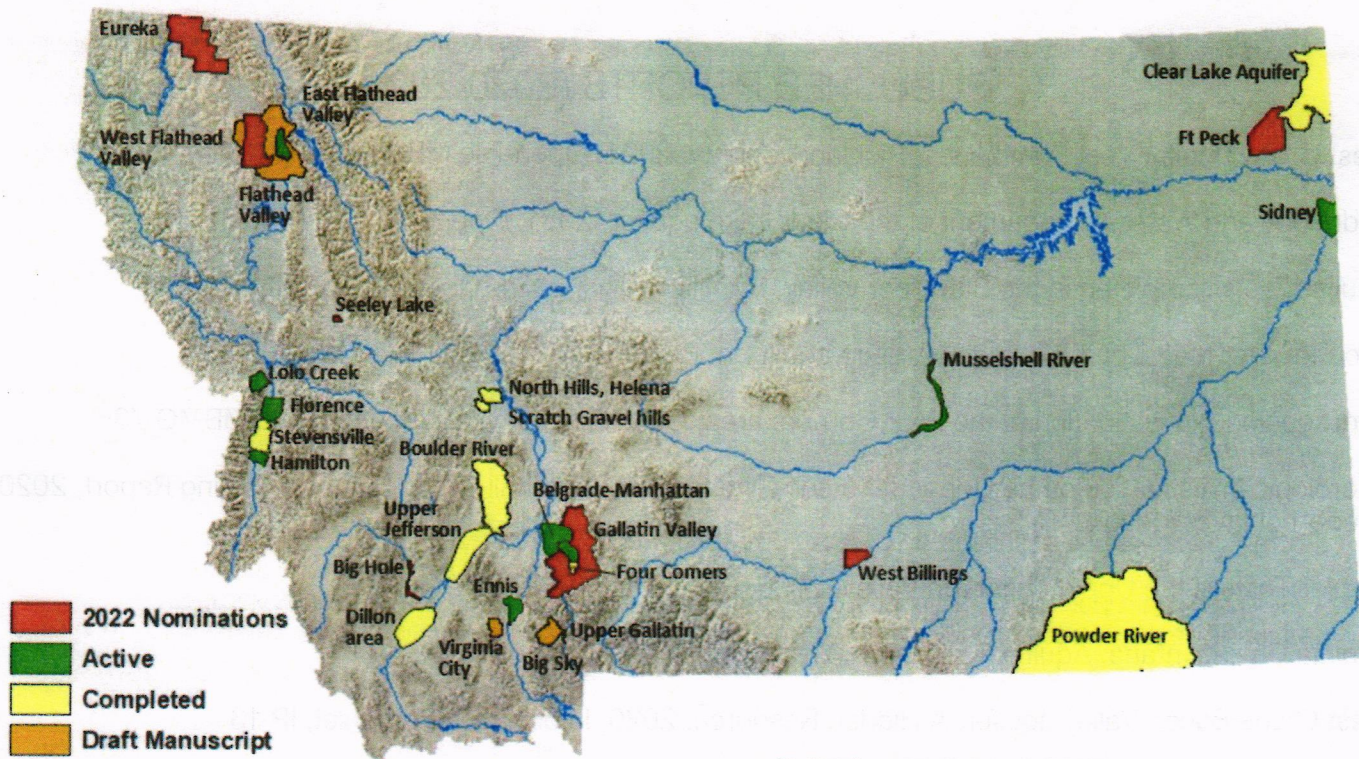


<https://www.nwrfc.noaa.gov/snow/snowplot.cgi?BSKM8>

Montana Bureau of Mines and Geology  
Ground Water Investigation Program

MBMG

July 2021



## PROJECT AREAS

### PUBLICLY AVAILABLE RESULTS INCLUDE

- ⇒ Detailed, peer-reviewed MBMG published reports, with more in review.
- ⇒ Computer models of site-specific groundwater flow are available for use.
- ⇒ Each project's scientific teams answer public inquiries regarding the hydrogeology of GWIP areas.
- ⇒ Comprehensive sets of hydrogeologic data for each investigation are publicly available in GWIC database.
- ⇒ Presentations to stakeholders and other interest groups.

The *Ground Water Investigation Program (GWIP)* answers locally identified, site-specific questions prioritized by the Montana Ground Water Steering Committee (MCA 85-2-525). As mandated by the Montana Legislature, GWIP conducts research on the most urgent water issues in the state.

FOR MORE INFORMATION CONTACT:  
GINETTE ABDO (PROGRAM MANAGER)  
(406) 496-4152  
gabdo@mtech.edu  
[www.mbmng.mtech.edu/WaterEnvironment/GWIP/main.asp](http://www.mbmng.mtech.edu/WaterEnvironment/GWIP/main.asp)

### **PUBLISHED REPORTS (2020-2021)**

West Crane Aquifer Test Summaries, Richland County, 2021, Open-File MBMG 737

Hydrology and Water Management of the Clear Lake aquifer, 2021, Open-File MBMG 738

Aquifer Tests completed in the Bitterroot Valley, Hamilton area, 2021, Open-File MBMG 739

Groundwater Model of the Meadow Village aquifer at Big Sky, 2021, Open-File MBMG 742

Hydrogeologic Investigation of the Four Corners area, Gallatin County, 2020, Open-File MBMG 735

Hydrologic Investigation of the Upper Jefferson River Valley, Whitehall Groundwater Modeling Report, 2020, Report of Investigations, RI 27

Aquifer Tests in the Upper Jefferson Valley, 2020, Open-File MBMG 727

Virginia City, Montana, Aquifer Test, 2020, Open-File MBMG 726

West Crane Buried Valley aquifer: A Hidden Resource, 2020, Information Pamphlet, IP 13

Hydrogeologic Investigation of the Stevensville area Ravalli County, 2020, Open-File MBMG 733

### **ACTIVE PROJECT SUMMARIES (2021)**

#### **Musselshell River** Musselshell, Rosebud and Petroleum Counties

**Purpose:** Determine the sources of salinity in the lower Musselshell River and in the Horse Creek Coulee near Melstone. High salinity irrigation water can result in crop yield loss, degraded soils and groundwater.

**Status:** Groundwater and surface water monitoring is ongoing through October 2021. Preliminary results show that groundwater salinity at 20 locations illustrates a variety of responses to canal leakage: mobilizing salts into the groundwater (Fort Union and Fox Hills Formations) or diluting high-salinity groundwater (Bearpaw shale).

**Personnel:** Liddi Meredith (Lead), Shawn Kuzara

#### **East Flathead Valley** Flathead County

**Purpose:** Determine the connection between the shallow aquifer, deep alluvial aquifer and surface water. This information will be used to evaluate the effects of pumping on these aquifers and on surface water.

**Status:** Groundwater and surface-water monitoring is ongoing through September 2021. Drilling and aquifer testing will occur August-October 2021. Groundwater model development is underway.

**Personnel:** Andy Bobst (Lead), Jim Berglund, Carly Peach

## ACTIVE PROJECTS (CONT.)

### Upper Gallatin Gallatin County

**Purpose:** Evaluate the effects of existing and future residential/commercial development in the Upper Gallatin Valley on water quantity and quality.

**Status:** Groundwater and surface-water monitoring is ongoing through August 2021. Aquifer tests are planned for September 2021. Groundwater model development is underway to predict groundwater availability and quality from increased residential development.

**Personnel:** James Rose (Lead), Ron Breitmeyer, Carly Peach

### Lolo Creek Missoula County

**Purpose:** Determine the cause of changes in streamflow character that occur in the lowest reaches of Lolo Creek, resulting in the channel occasionally being dry.

**Status:** Groundwater model development and report preparation are underway. The geologic framework and water budget are complete. The model will help quantify the water budget and the effects of hydrologic stresses on Lolo Creek.

**Personnel:** Ali Gebril (Lead)

### Sidney Area-West Crane Buried Valley Aquifer Richland County

**Purpose:** Determine the availability of water from the buried channel aquifer in the Sidney area and the aquifer's ability to meet the needs for future municipal, irrigation, and oil and gas development.

**Status:** Data collection is complete. A numerical groundwater model is being developed to simulate hydrogeologic conditions and make predictions on the effects of irrigation pumping on groundwater and surface-water. Report preparation is underway.

**Personnel:** Jon Reiten (Lead), Kevin Chandler

### Ennis Area Madison County

**Purpose:** Investigate the effects of increased residential development and groundwater withdrawals in the bedrock aquifer on the west side of the Ennis Valley. Implications for increased withdrawals on adjacent aquifers will be considered.

**Status:** Data collection is complete. Data interpretation and report preparation will commence in 2022.

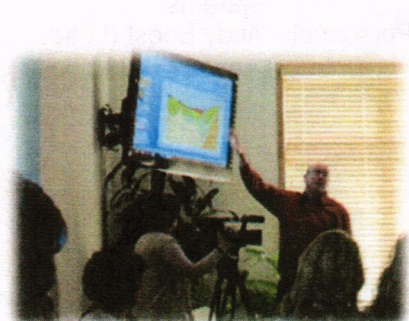
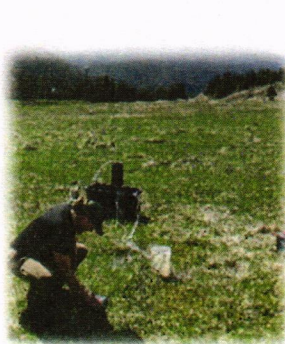
**Personnel:** Mary Sutherland (Lead)

### Hamilton Area Ravalli County

**Purpose:** Provide detailed hydrogeologic information that can be used to examine the effects of land use changes on groundwater and surface-water. Evaluate nitrate concentrations as an indication of residential growth and associated increase in septic systems.

**Status:** Data interpretation is complete and the draft report is in review.

**Personnel:** Todd Myse (Lead)



*Developing the hydrogeologic framework, monitoring, and communicating results to the public.*

## IN REVIEW

### **Belgrade/Manhattan** Gallatin County

- Purpose:** Assess the effects of pumping from high capacity wells for a municipality or subdivision on groundwater and surface-water resources.
- Results:** The valley geology dictates the ideal location of a high yield water supply. Thick sediments in the central valley are conducive to development with the distance to surface water and the timing of mitigation considered for minimizing effects.
- Personnel:** Mary Sutherland (Lead)

### **Big Sky** Gallatin and Madison Counties

- Purpose:** Evaluate the sustainability and production capacity of the Meadow Village Aquifer and the feasibility of groundwater withdrawals from bedrock aquifers in the Big Sky area.
- Results:** Geology and structure have an influence on aquifer productivity (report in review). A second report (Open-File MBMG 742) showed that as much as 20% of baseflow to the Middle Fork of the West Fork Gallatin River is contributed by groundwater discharge and that increased well withdrawals may result in a 1:1 relationship between increased pumping and decreased streamflow gain by the Middle Fork.
- Personnel:** James Rose (Lead)

### **Flathead Valley** Flathead County

- Purpose:** Determine whether withdrawals from the deep aquifer affect surface-water resources; and if current stresses are creating declining water-level trends.
- Results:** Pumping has created water-level declines in some areas, but not valley-wide. The deep sand and gravel aquifer is protected from surface activities by an overlying confining unit. This unit also constrains pumping drawdown to the deep aquifer. A 3-dimensional hydrostratigraphic model (MBMG Open-File 703) allows future users to access lithologic information for any location in the valley.
- Personnel:** James Rose (Lead)

### **Virginia City** Madison County

- Purpose:** Estimate sustainability of the public water supply springs under scenarios of increasing demand and adjacent future development. Investigate potential of augmenting the municipal springs with a well(s).
- Results:** The municipal springs emanate from the contact between overlying lava flow deposits and tuffs. Preliminary results indicate that the springs are susceptible to effects from surface activities and septic systems.
- Personnel:** Andy Bobst (Lead)

**SUPPORTING SCIENCE-BASED WATER  
MANAGEMENT FOR MONTANA**

The Ground Water Investigation Program (GWIP), established by the 2009 Legislature (HB 52), applies scientific research to answer the most urgent water issues in Montana.

**Current topics of investigation include:**

- The effects of changing to more efficient irrigation methods (i.e., converting from flood to pivot irrigation) on groundwater availability and surface-water flows
- Aquifer and stream response to changing land use from irrigated agriculture to residential development
- Hydrogeologic viability of replacing surface-water diversion points with irrigation wells
- Groundwater sustainability in response to increasing residential, irrigation, and commercial development
- Changes in water quality due to increasing subdivisions
- Groundwater availability of buried river channel aquifers



*Collecting drill cuttings to identify aquifers in the Flathead Valley.*

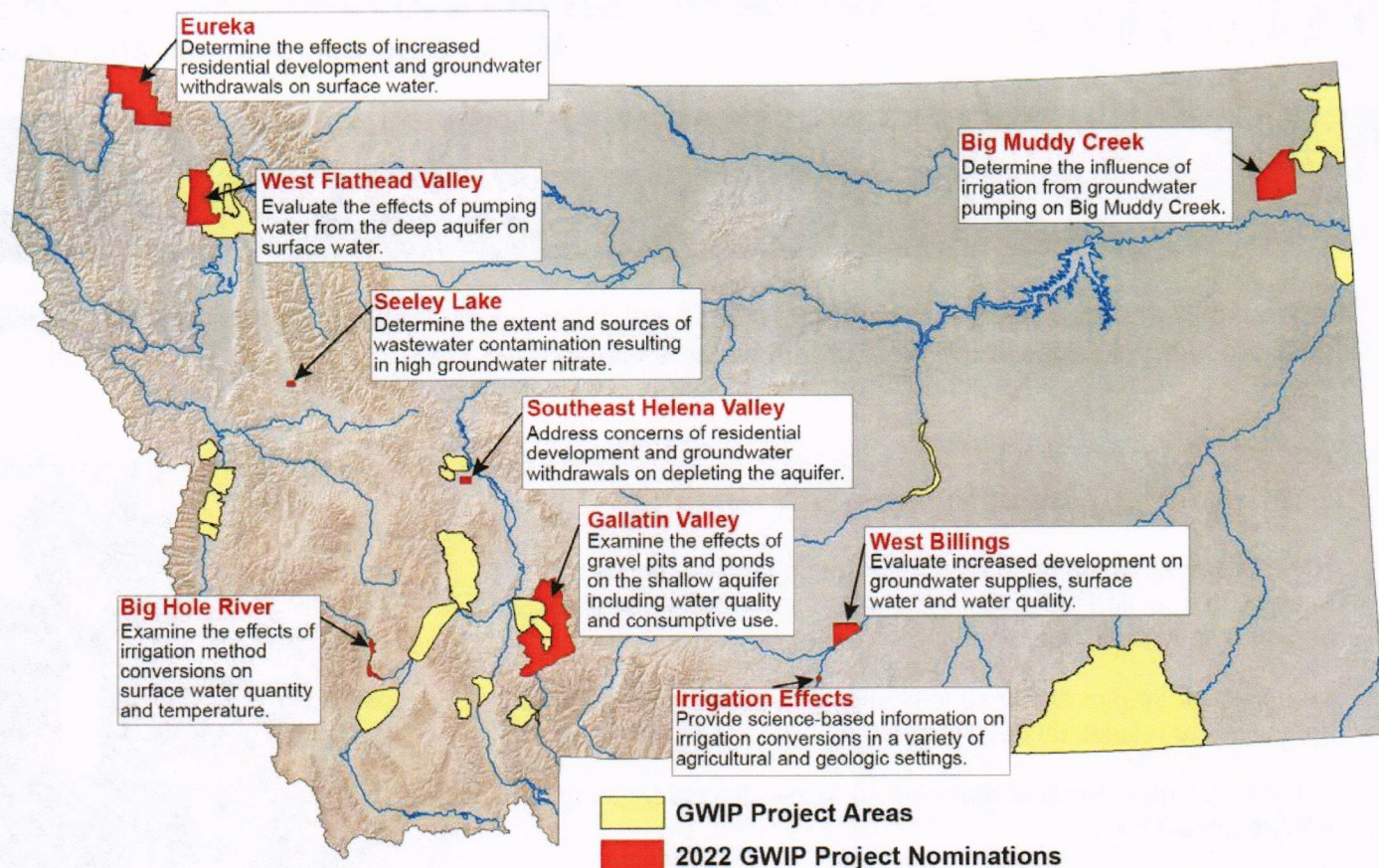
To date, over 85 projects have been nominated and prioritized by the Ground Water Steering Committee. Results of GWIP projects have been used in water rights permit decisions, water resource development, and county planning.

**Latest Projects:**

- **Musselshell River** (Musselshell and Petroleum Counties)—Investigate the sources of salinity in the lower Musselshell River. High-salinity irrigation water can result in crop yield loss, degraded soils, and groundwater.
- **East Flathead Valley** (Flathead County)—Evaluate sustainable new groundwater development and groundwater/surface-water interaction. Conflicts over water rights occur because of the lack of information.
- **Upper Gallatin Corridor** (Gallatin County)—Determine the effects of increased residential and commercial development on water availability and quality.

**For more information: [mbmg.mtech.edu/WaterEnvironment/GWIP/main.asp](http://mbmg.mtech.edu/WaterEnvironment/GWIP/main.asp)**

## Water Management Tools for Montana



## Water-Related Education and Outreach

The public receives results in reports, presentations, and individual questions to the scientists:

- Over 20 peer-reviewed MBMG reports have been published to date.
- Computer models of site-specific groundwater flow are available to the public for continued use.
- Scientists are available to the public for questions and presentations.
- Comprehensive set of hydrogeologic data for each site are permanently stored online.



**January 27, 2020:** Upper Jefferson River study:  
 “With the completion of the upper Jefferson River Groundwater Investigation there now is definitive information on the potential impacts, and key areas of concern.”



### Water Wisdom: Mining for Water



**Jul 30, 2020:** Researchers from the Montana Bureau of Mines and Geology conducting groundwater studies in Gallatin Canyon. Photo courtesy of the Gallatin River Task Force.



## **GROUND WATER ASSESSMENT PROGRAM**

Montana Bureau of Mines and Geology

### **CHARACTERIZING MONTANA'S AQUIFERS**

The Ground Water Assessment Program (GWAP), established by the 1991 Legislature, is tasked to improve the understanding of Montana's groundwater resources by collecting, interpreting, and disseminating essential groundwater information. This information is vital for making science based management decisions.

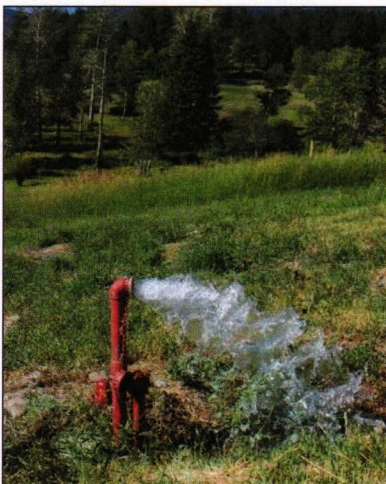
- "Montana's citizens depend on groundwater..."
  - "groundwater supplies are threatened..."
  - "there is insufficient information characterizing..."
  - "groundwater information deficiencies are hampering..."
  - "...focus on preventing groundwater contamination...but better ground water information is required"
  - "there is a need for better coordination among those numerous units of state, federal, and local government..."
- (85-2-902(1) MCA)

#### **Program Components:**

1. Ground Water Monitoring: to produce and maintain long-term water-level and water-quality records,
2. Ground Water Characterization: to systematically assess and document the hydrogeology and quality of the state's major aquifers,
3. Ground Water Information Center (GWIC): to make groundwater information widely available.

#### **Program Oversight:**

An interagency Steering Committee selects study areas, coordinates groundwater research among state, federal, and local government units, and oversees Assessment Program progress.



#### Voting Members (by statute):

Department of Natural Resources  
Department of Environmental Quality  
Department of Agriculture  
Montana State Library

#### Ex Officio Members (Governor Appointees):

Agricultural water users  
Industrial water users  
Conservation or ecological organization  
Development community

#### Other:

MT University System, Legislative Services Division, Board of Oil and Gas Conservation, Bureau of Land Management, U.S. Geological Survey, U.S. Bureau of Reclamation, U.S. Forest Service, U.S. Environmental Protection Agency

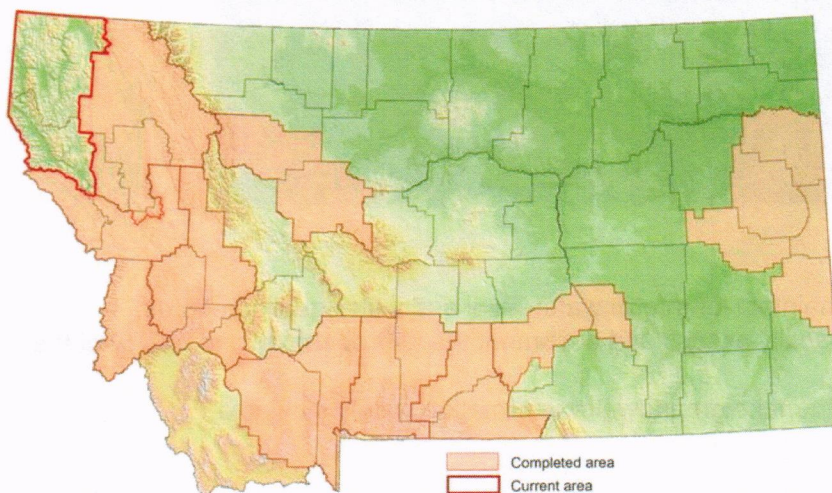
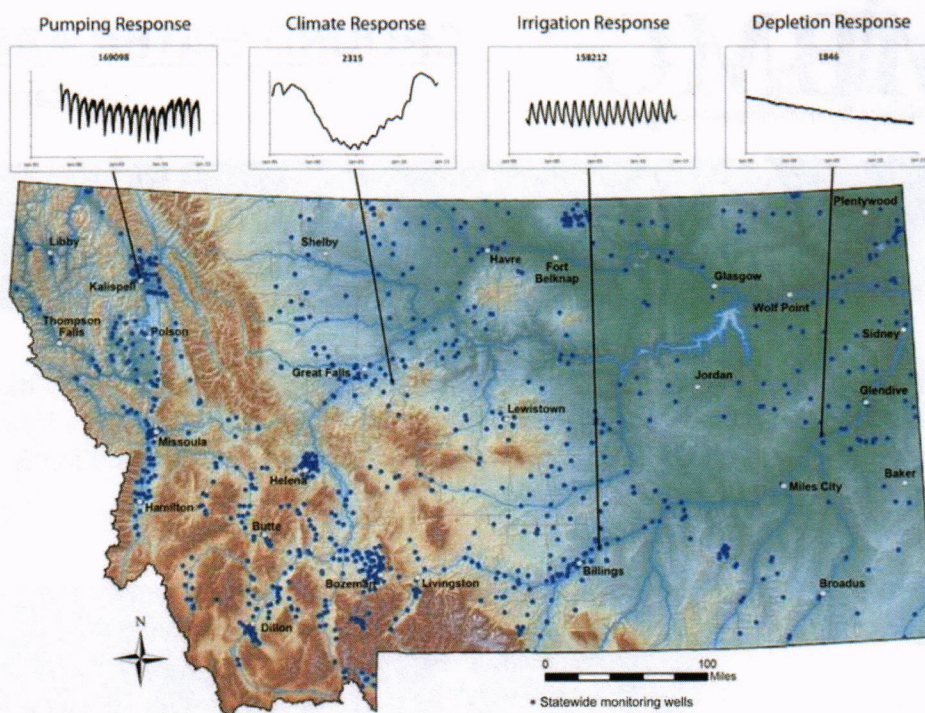
**For more information: [mbmg.mtech.edu/WaterEnvironment/AquiferCharacterization/](http://mbmg.mtech.edu/WaterEnvironment/AquiferCharacterization/)**

## Ground Water Monitoring

### Collecting Baseline Water-Quality and Water-Level Data

Long-term data collection from 900+ strategically located wells provides the data necessary to track changes in water levels and water quality in Montana's major aquifers.

*All data, maps, and reports are available at no charge from the GWIC database.*



## Characterization Program

### Compiling information on Montana's groundwater resources

- Fieldwork complete in 9 areas (24 counties)
- High-quality data from more than 9,000 wells
- Groundwater samples from more than 3,000 wells
- Released 67 maps and reports describing groundwater conditions

## Ground Water Information Center—GWIC

### Montana's official repository for groundwater information

- Data and other information are available online
- Well logs, water-quality and water-level data, hydrographs, maps, and reports are stored in the database and can be accessed online at no charge. New capabilities include an interactive web mapping application.

